Fighting COVID-19 pandemic: linear responses for a complex problem

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Abstract. The global interest and concern over the COVID-19 pandemic has shifted the attention of governments and international organisations away from urgent problems such as the climate crisis. In most international fora and meetings over the past year, attention has focused successively on medical care and hospital conversion, containment and, more recently, vaccines. The current emphasis on immunisations has been, if not the only, the predominant action, which does not correspond to the complexity of the determinants of the pandemic. This paper reviews critically the main factors that have caused the expectation that the focus on vaccines may not be matched by the expected results. It reviews a series of technical and political actions that, in addition to vaccines, should contribute to the control of the pandemic and, above all, create the conditions to prevent the emergence of new pandemics. From the perspective of the experience in Mexico, the challenges involved in vaccination against COVID-19 based on a mosaic of vaccines are reviewed, a situation similar to what will occur in other countries. In addition to vaccination, significant reduction of size and number of food animal farms and improvement of their biosecurity standards, accompanied by a profound reorientation of food consumption patterns are urged as the most important actions to prevent new pandemics and to reduce morbidity from diseases that have significantly increased the severity and mortality by COVID-19.

Resumen. El interés y la preocupación mundial que ha acaparado la pandemia por COVID-19 ha desplazado de la agenda de los gobiernos y organizaciones internacionales la atención a problemas urgentes como la crisis climática. En la mayoría de los foros y reuniones internacionales, desde hace un año, la atención se ha centrado sucesivamente en la atención médica y la reconversión hospitalaria, el confinamiento y más recientemente, las vacunas. El énfasis que actualmente ha puesto a las inmunizaciones ha sido, sino la única, la acción predominante; lo que no se corresponde con complejidad de los determinantes de la pandemia. En este escrito se hace una revisión de las principales factores que causar que la expectativa que se ha centrado en las vacunas no sea correspondida pueda no tener resultados esperados. Se hace una revisión de una serie de acciones técnicas y políticas que, además de las vacunas, deberían contribuir a un control de la pandemia y, sobre todo, crear las condiciones para evitar el surgimiento de nuevas pandemias. Desde la perspectiva de la experiencia en México, se revisan los retos que implica la vacunación contra la COVID-19 con base a un mosaico de vacunas, situación semejante a lo que ocurrirá en otros países. Además de la vacunación, se insta a reducir significativamente el tamaño y el número de las encierros de animales destinados a la alimentación y a mejorar sus normas de bioseguridad, acompañadas de una profunda reorientación de los patrones de consumo de alimentos, como las acciones más importantes para prevenir nuevas pandemias y para reducir la morbilidad de las padecimientos que han aumentado significativamente la gravedad y la mortalidad por COVID-19.

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The vaccines to prevent COVID-19 that have received emergency approval from the World Health Organisation and health authorities in more than twenty countries received this approval as a result of an evaluation that has rated them as safe and effective in their initial testing phases, but above all because in the face of the serious health emergency, it is claimed, there are no suitable, approved or available alternatives[1].

There is, however, growing concern that the effectiveness of the vaccines against the new variants of SARS-Cov-2 is limited, because they were all developed according to the genomic structure of the SARS-Cov-2 virus at the beginning of the pandemic.

Although the coronavirus responsible for the current pandemic mutates at a slower rate than other RNA viruses, it is constantly evolving and is subject to a multitude of adaptive pressures, almost as diverse as the variety of contexts and populations in which it is present[2]. Despite the significant reduction in productive activities and travel restrictions that have been maintained in many parts of the world, pandemic-affected populations are in constant interaction, a fact that is evidenced by the rapid spread of the virus and its strains. The pandemic is therefore much more than the sum of the epidemiological situations of each and every affected country; hence its complexity.

The beginning of 2021 was marked by news from different regions of the world of the emergence and spread of new strains of SARS-Cov-2. Hundreds of thousands of modifications of the virus have been identified, but the vast majority of these are of no epidemiological significance. Some, however, may be more infectious and/or virulent.

It was recently claimed that one of the variants of epidemiological concern, identified since September 2020 in the UK, will soon be the predominant strain worldwide. The concern generated by this virus strain has been extended to include variants originating from other parts of the world. Their common feature is increased transmissibility, a characteristic that, for virus dynamics, offers greater potential for replication. It is claimed that the transmissibility of these strains can be 50 to 70 percent higher than in the original virus.

The head of Britain's leading virology laboratories has said that because of the evolutionary characteristics of SARS-Cov-2, it will be necessary to monitor changes in its genetic sequence for at least ten years[3]. The variant of the virus that was first identified in the UK county of Kent, due to its increased contagiousness, has become dominant in Britain, as well as spreading to more than fifty countries in a matter of weeks. It is a variant that continues to mutate, most recently giving rise to two more variants with major mutations in Bristol and Liverpool. The first of these, known as VOC 202102/02, has a mutation of the E484K spike protein, which some experts believe could help the virus get past the body's immune defences and reduce the effectiveness of vaccines. The variant found in Liverpool, in addition to the spike protein mutation, has several other mutations. The picture is complicated by the fact that in the UK itself, cases of the South African variant are also

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[1] *FDA,* ***Emergency vaccine approval, explained*** *https://www.fda.gov/vaccines-blood-biologics/vaccines/explicacion-de-la-autorizacion-de-uso-de-emergencia-para-las-vacunas*

[2] *McCarthy K. R. et al, Recurrent deletions in the SARS-CoV-2 spike glycoprotein drive antibody escape.* ***Science*** *03 Feb 2021: eabf6950. DOI: 10.1126/science.abf6950 Available in: https://science.sciencemag.org/content/early/2021/02/02/science.abf6950*

[3] *Gray, R*, *This is how the new COVID-19 variants are changing the Pandemic,* ***Future. The BBC****, January 21, 2021. Available in: https://www.bbc.com/future/article/20210127-covid-19-variants-how-mutations-are-changing-the-pandemic*

multiplying, and there have also been some cases of one of the two variants from Brazil[4] [5]. What is happening in the UK, a country with greater technical resources to conduct virus sequencing studies than most other countries, provides a window through which we can see what may well be happening in other countries as well, albeit unnoticed.

In addition, the UK New and Emerging Respiratory Virus Threats Advisory Group has reported that there are indications that in addition to their increased infectiousness, the new variants of the virus are associated with an increase in severe forms of COVID and a similar distribution among men and women. An increase in these same severe forms of COVID has also been reported among young people with no apparent risk preconditions[6]. The number of COVID-19 deaths per population in the UK is currently the third highest in the world (172.5 per 100,000)[7].

In early February 2021, a new mutation known as E484K[8] was detected, which, according to some studies, is more difficult for vaccines to combat. This strain is said to have originated locally from the UK strain, and there are already thousands of cases in the US.

Because this new strain is characterised by high transmissibility and an increased ability to evade the immune system after vaccination, if it spreads, it could overtake the UK B1.1.7 as the dominant strain of the virus in other regions, including the United States.

It is not yet known whether recently approved vaccines will be effective in containing the new strains of the coronavirus. Their increased transmissibility challenges the speed with which organisms can develop an immune response that confers reliable protection when vaccinated.[9] Despite the evidence from the studies being published in many parts of the world on COVID-19, new questions are emerging just as quickly. This contrasts with the certainty with which international agencies and governments claim that approved vaccines will be the solution.

One of the most worrying problems could be that the evolution of the virus could lead to the emergence of strains that can replicate faster than the development of vaccine-generated immunity, or even affect the vaccine-generated immune response. It is plausible that because this antibody response is so focused on the spike protein, mutations in the

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[4] *Russell, COVID-19: New SARS-CoV-2 Mutation Found in Bristol 'Of Concern' - Medscape - Feb 10, 2021.*

[5] *CDC, About Variants of the Virus that Causes COVID-19, February 12, 2021. Available in: https://www.cdc.gov/coronavirus/2019-ncov/transmission/variant.html*

[6] Cock van Oosterhout, Neil Hall, Hinh Ly & Kevin M. Tyler (2021) COVID-19 evolution during the pandemic – Implications of new SARS-CoV-2 variants on disease control and public health policies, **Virulence**, January 21,2012. 12:1, 507-508, DOI: 10.1080/21505594.2021.1877066

[7] *Statista 2021, Coronavirus (COVID-19) deaths worldwide per one million population as of February 12, 2021, by country. Available in: https://www.statista.com/statistics/1104709/coronavirus-deaths-worldwide-per-million-inhabitants/*

This source also indicates that the world´s highest number of deaths per number of inhabitants corresponds to Belgium (187.6 x 100,000). Mexico has the highest number of the Latin American countries with 134.2.

[8] *Wise, J, Covid-19: The E484K mutation and the risks it poses, **BMJ,** P; 372 doi. Published on line February 5, 2021 Available in: https://doi.org/10.1136/bmj.n359*

[9] Hoffmann M, Arora P, Groß R, et al**.** SARS-CoV-2 variants B.1.351 and P.1 escape from neutralizing antibodies. **Cell**, 16 March 2021. Available in: https://doi.org/10.1016/j.cell.2021.03.036

sequences of this part of the virus may surge due to antigenic drift, selection during natural infections or vaccine-generated immune responses[10].

The above possibility provides an indication that the mosaic of immune responses that will be generated by the wide variety of SARS-COV2 vaccines being administered in countries such as Mexico could favor the development of strains with the capacity to affect the immune response. The problems that can be generated by the application of diverse vaccines can have unforeseeable consequences. Such as?

It must be borne in mind that viruses in general, and SARS-Cov-2 in particular, are always in the lead; this means that the evolution of the virus is very likely faster than the efforts deployed to tackle the new varieties of the virus. The urgency and haste with which vaccines are being developed, tested, evaluated, approved and finally applied make it impossible to clearly establish their safety margins and stability; conditions that would not be acceptable without the profound crisis that the pandemic continues to produce, as the duration of immunity and its protective capacity are not known, especially in the face of mutations resulting from the evolution of the virus. It appears that vaccines will have to be periodically redesigned, as is already the case with influenza vaccines, which will endlessly lengthen the dependency and enormous resources that countries will have to spend on their acquisition, impoverishing and draining the resources of their health systems to prevent and care for other health problems. This will undoubtedly cause massive setbacks and inequalities in the right to health.

The urgent attempt to halt the relentless rise of the new coronavirus and its health and economic consequences has been distorted by geopolitical and economic interests that make it even more difficult for governments and international organisations to decide which measures to take in the face of the pandemic.

II. A mosaic of vaccines

The COMIRNATY vaccine's risk-benefit balance was the criterion ~~for~~ used by the World Health Organisation to grant the first authorisation for its production and application against COVID-19 hours before the end of 2020. The licensing of this vaccine, designed by BioNTech and produced by Pfizer, fueled hope for an end to the pandemic, but also marked the beginning of a competition for registration for other vaccines. Until the end of January 2021, this race was characterised by pronounced starkly contrasting prospects. The bright side is the hope that vaccines will act as fuel for an end to the human suffering more than a year into the pandemic, which has infected more than 13.5 percent of the world's population and by the end of February 2021 had caused 2.5 million deaths. It is also an unprecedented feat that in less than twelve months, research teams from around the world have worked painstakingly to create more than a dozen vaccines that are either potential candidates for or are in the process of being approved for emergency use. The dark side, which is only just beginning to emerge, is, first and foremost, the deep politicization under which vaccines are being developed, produced and distributed. The self-serving competition and hoarding of vaccines by higher-income countries since the start of 2021 has prompted Dr Tedros Adhanom Ghebreyesus, head of the World Health Organisation, to issue an unusually

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[10] *Williams C T y Burgers A W, SARS-CoV-2 evolution and vaccines: causes for concern* ***Lancet Respir Med****. Published online: January 29,2021. Available in: HTTPs://doi.org/10.1016/S2213-2600(21)00075-8*

urgent call to avoid "catastrophic moral failure"[11]. The Trump administration's moves to hoard vaccines for the US population through giant advance purchases and the European Union's restrictions on vaccine exports were only the beginning of a new kind of health policy confrontation, which is becoming the new mode of confrontation and competition between countries. Undoubtedly, for some, vaccines are a new instrument to prevent further human suffering; for others, however, vaccination is seen through the prism of profit, economic interests and political influence. It is not difficult to foresee that vaccination to prevent COVID-19 will deepen inequalities between countries and, within countries, between social classes. In response to a well-founded fear and before any vaccine was approved, the UN Committee on Economic, Social and Cultural Rights issued a statement in November 2020 on the importance of universal access to vaccines against COVID-19, based on international law[12].

Following the WHO approval of the Pfizer/BioNTech vaccine, several other vaccines have been approved by national authorities for use in emergencies, such as the Astra Zeneka-Oxford University vaccine by the UK health authorities, while the US authorities had only approved the use of the Moderna-developed vaccine in addition to the Pfizer/BioNTech vaccine by the end of January. The Johnson and Johnson-developed vaccine has been the most recent to be approved in the US, largely driven by the fact that it requires a single dose. However, it is not possible to rule out that its approval and its production through a partnership of normally rival pharmaceutical consortia is also driven by US geopolitical interests in the face of the rapid expansion of vaccines developed in China and Russia in Asia and Latin America. In this way, national health authorities also function as market regulators. It is also foreseeable that health authorities will relax their criteria for authorising the use of vaccines according to availability, access, price and the demands of each country's population. As a result, lower-income countries will be slower to meet their vaccine requirements and will need to increase the initial diversity of vaccines, inevitably making their COVID-19 vaccination programs a mosaic, which in turn will generate another mosaic, more difficult to decipher: the mosaic of immune responses. This situation, which is difficult to avoid due to limited production, distribution and availability of vaccines, exacerbated by competition, poses several potential problems:

1. *Difficulties in proper planning of vaccination, as well as in monitoring and follow-up.*
2. *Limitations in clearly identifying the degree and type of protection against COVID-19 required by vaccinated populations.*

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[11] *Covid vaccine: WHO warns of "catastrophic moral failure". Available in: https://www.bbc.com/news/world-55709428*

[12] *Statement by UN Human Rights Experts Universal access to vaccines is essential for prevention and containment of COVID-19 around the world. November 9 2020. Available in: https://www.ohchr.org/EN/HRBodies/HRC/Pages/NewsDetail.aspx?NewsID=26484&LangID=E*
Fulfill their responsibilities, including through the exercise of human rights due diligence to identify and address adverse impacts on the rights to life and health, as set out in the Guiding Principles on Business and Human Rights. In particular, they should refrain from causing or contributing to adverse impacts on the rights to life and health by invoking their intellectual property rights and prioritising economic benefits. missing words? B4Fulfill? International financial institutions (IFIs), in accordance with their human rights obligations under international law, should: Ensure that the grants and loans they provide to developing countries contribute to expanding their capacity to procure, manufacture and distribute safe, effective and affordable COVID-19 vaccines. To this end, IFI country programmes on COVID-19 vaccines should be aligned with a globally coordinated approach, such as the COVAX Global Vaccine Centre.

3. *Prospective monitoring of vaccination will be difficult because the duration of protection conferred by each vaccine is not known.*
4. *Conflicts may also arise due to particular populations' demand for or rejection of a particular type of vaccine.*

Most of these difficulties are virtually unavoidable in the early stages of vaccination, but it would be sensible to move in a direction where the initial vaccination mosaic is diminishing, or in large countries such as Mexico, to consolidate vaccinated regions with a minimum diversity of vaccines.

At the global level, it will be very difficult, if not impossible, for the WHO to recommend the preferential use of some vaccines, even though some have stood out more than others in terms of the level of protection and safety they provide. A global complex and irregular mosaic of immunisations will very likely result from the disparities in the access to vaccines interweaved with a multitude of political and geostrategic factors, that will exacerbate in countries where many public health decisions depend of external factors.

This mosaic may have more unpleasant repercussions, if it turns out - as some indications already suggest - that the protection of some vaccines is limited against new strains of a virus that is constantly and rapidly evolving. Although it is widely believed that the only sustained way to contain the pandemic is to achieve herd immunity in the population, and that the only acceptable way to achieve this is vaccination, it is not yet known precisely what is the minimum percentage of the population that should be vaccinated, as the literature ranges from 20 to 90 per cent[13] [14]. There is no evidence that the application of a diverse types of vaccines in the same population will contribute to effective herd immunity with the same effectiveness than with the use of a more homogenous types of vaccines for COVID-19.

A worse scenario could arise, if the mosaic of immune responses is produced in regions where a significant segment of the population remains unvaccinated, affecting the evolution of the SARS-COV-2 virus and thus, contributing to the emergence of new strains.

III. Linear responses to complex problems

Vaccines is being hailed worldwide as the silver bullet that will end the COVID-19 pandemic once and for all. The 73rd World Health Assembly (WHA73), the highest governance body of the WHO, was held in an unusual way in May 2020, as, due to the pandemic, it took place virtually and lasted only a day and a half, in contrast to the usual face-to-face assemblies in Geneva, attended by several thousand delegates from all member countries, with an extensive two-week agenda of issues. WHA73 focused exclusively on the COVID-19 pandemic and mostly on vaccine development. During the assembly, none of the delegates made any mention of the industrial production of animals for human consumption or the removal of wild animals from the wild, which are the most clearly identifiable structural determinants of the two pandemics that humanity has suffered this century. Much less was said about the need to implement actions to improve biosecurity measures or to analyse the

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13 Randolph, HE, Barreiro, LB. Herd immunity: understanding COVID-19**. Immunity**. 2020;52(5):737-741.

14 *James, J. Are we "Waiting for Godot" – a metaphor for COVID-19.* ***Disaster Med Public Health Prep***. 2020;epub, 1-3. Available in: https://doi.or/0.101/mp.2020.280.

possibilities of reducing the size of Confined Animal Feeding Operations (CAFO's) \ as one of the most important preventive measures that should be implemented in aim to reduce the risk of new zoonotic pandemics of the same or greater proportions than the current COVID-19 one, in addition to the impact that these massive confinements of birds and mammals have on climate change[15] [16]. Prior to the emergence of the COVID-19 pandemic, it was anticipated that the health impact of climate change would be the focus of the WHA73 due to its urgency.

Although there were some mentions of obesity, diabetes and other metabolic diseases as underlying conditions for severe cases of COVID-19 and deaths, as in the intervention of the Mexican Secretary of Health, these failed to prevent hospital conversion and vaccines from being the hegemonic themes of the assembly.

One international event whose importance was overshadowed by the pandemic was the launch of the report of a WHO/UNICEF/Lancet commission on an extensive global analysis of a set of indicators related to children's health and well-being over the coming decades[17]. This report was prepared over several years of work and should have been a relevant input to the WHA73 and other international events, as the report concludes that climate change, pollution and commercial pressures that encourage unhealthy lifestyles will prevent the next generations from accessing conditions of health and well-being, even in the countries with the best indicators, if governments and international agencies do not act quickly and effectively. The pandemic not only distracted attention by literally erasing these issues from the international agenda, but added yet another threat to the world's children, who will, in the medium and long term, be the population most affected by the indirect effects of COVID-19: orphanhood, school dropouts, violence and poverty compound the threats that the report was intended to warn about.

The pandemic has motivated an overwhelming variety of clinical studies and prompt publication of their results. The scale of experimental studies to test drugs and vaccines is unprecedented globally, and there has probably never been such a large number of people willing to participate as subjects in these studies. However, some critics warn that the "deluge" of small, hastily conducted studies is contributing to confusion and sabotaging the development of consistent evidence on the efficacy of treatments for COVID-19 [18]. Most likely, something similar could happen in relation to vaccines.

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[15] *Agricultural emissions form a significant part of total food systems emissions, which go beyond farmers' fields and land-use activities to include processes in food manufacturing, refrigeration and transportation, food supply chains, retail processes, food consumption and food waste disposal. Food systems produced between 21-37% of the world's total annual CO2 emissions for 2007-2016 (Rosenzweig et al., 2020), while FAOSTAT estimates for the same period that agriculture alone contributes 21% of these emissions.*

[16] *FAO*, *The Contribution of Agriculture to Greenhouse Gas Emissions FAO. 2020. http://www.fao.org/economic/ess/environment/data/emission-shares/en/*

[17] 17 Clark H et al., A Future for the World´s Children A WHO-UNICEF-Lancet Commission, **The Lancet** Vol 395, issue 10224 pp605-658 Febrero 22 de 2020. Disponible en: https://www.thelancet.com/journals/lancet/issue/vol395no10224/PIIS0140-6736(20)X0008-0

[18] *Glasziou P.P, Waste in covid-19 research, BMJ 2020; 369. Disponble en: https://doi.org/10.1136/bmj.m1847*

In contrast, there are other areas of research that are less in demand, but which point to other fields of knowledge that may offer alternative approaches to the prevention, diagnosis and treatment of COVID-19. Studies of the gut microbiota could provide important clues for a nutrition and primary care approach, and may even help to better understand the natural or vaccine-induced immune response. Some research has already shown that early manifestations of severe forms of COVID can be identified through changes in the oral and gut microbiota[19]; findings that also point to the development of preventive and therapeutic alternatives. Other descriptive studies have highlighted non-breastfeeding history as a risk factor for severe forms of COVID-19 and COVI-19-related fatality[20]. This evidence reinforces the wealth of knowledge available that breastfeeding is a fundamental pillar of lifelong immune system development.

One of the most underappreciated fields in COVID-19 research is that of herbalism and traditional medical practice and medications. At the beginning of the pandemic, due to the precarious conditions, lack of water and overcrowding in several regions of Mexico, it was foreseen that the consequences of COVID-19 would be devastating. The fact that the catastrophic scenarios that were feared have not materialized is probably not only due to under-reporting, but also to the fact that the populations have resorted to the use of plants and other traditional remedies. In China and other countries where traditional medicine has been better recognised and more systematically studied, there have been abundant studies on the use of plants to reduce severe forms of COVID-19, with published articles showing promising results[21]. In countries such as Mexico, where only anecdotal and qualitative descriptions have been produced, it would be reasonable to promote clinical studies on the effectiveness of traditional preparations to reduce transmission and prevent severe forms of the disease. Several international articles promoting an integrated approach to COVID-19 point to commonalities in the type of plants and foods that have been used in different regions of the world to prevent and treat viral respiratory tract infections in the past and in the way, they are currently being used for COVID-19. The anti-inflammatory properties of some foods and herbals, as well as their effect to reduce oxidative stress offer a promising field for prevention and treatment of mild COVID-19[22]. Although some institutions already have some protocols in place for the study of such resources, encouragement and support for such studies could be a promising strategy for a culturally and biologically megadiverse country like Mexico, and could help alleviate the budgetary burden of prolonged dependence on the purchase of drugs and vaccines.

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[19] Doyle V. Ward, The intestinal and oral microbiomes are robust predictors of COVID-19 severity, the main predictor of COVID-19-related fatality, **COVID-19 SARS-CoV-2 preprints from medRxiv and bioRxiv**. Publicado el 06 de enero, 2021. Available in: https://doi.org/10.1101/2021.01.05.20249061

[20] *Altug Didikoglu, A et al, Early life factors and COVID-19 infection in England: A prospective analysis of UK Biobank participants,* ***Early Human Development*** *Vol. 155, April 2021, 105326 . Available in: https://doi.org/10.1016/j.earlhumdev.2021.105326*

[21] *Alschuler L et al, Integrative considerations during the COVID-19 Pandemic,* ***Explore*** *Vol. 16 (2020) 354-356*

[22] *Mohammed Iddir et al, Strenghtening the Immune System and Reducing Inflammation and Oxidative Stress through Diet and Nutrition: Considerations during the COVID-19 Crisis,* ***Nutrients*** *(2020) 12, 1562; doi:10.3390/nu12061562*

IV. A coronavirus that is here to stay

In mid-February 2021, the journal Nature[23] published the results of a survey of more than 100 of the world's leading immunologists on how they think the virus and the pandemic will evolve. There is near consensus that *SARS-Cov-2* will not be eradicated and that it will join the viruses that *after* triggered *former* pandemics *became endemic. D*ue to the natural immune response of affected populations *and* the use of vaccines, *many of these viruses* declined in occurrence an*d in the causation of* severe forms of the disease, becoming endemic in some *regions*, with seasonal outbreaks. *If* a high percentage of the population *is* immunised with a highly effective vaccine, the virus can be eradicated in some regions of the world, but there will always be the possibility that it can be reintroduced from regions where health actions are weaker. The immunologists agree that the duration of immunity and the efficacy of vaccines will play an important role, but warn of the possibility of the virus escaping and even infecting other animals, which could serve as reservoirs, with the capacity to produce new outbreaks. In the face of these threats, even if they are not the most likely scenario, actions should be implemented which, once again, make it necessary to think about other levels of action in addition to vaccines.

Zoonotic pandemics, such as that caused by SARS-CoV-2, can follow the spread of animal viruses in highly susceptible human populations. Their descendants have adapted to the human host and evolved to evade immune pressure. Coronaviruses acquire substitutions more slowly than other RNA viruses, due to a proofreading polymerase[24]. In the spike glycoprotein we find recurrent deletions that exceed this slow substitution rate. Deletion variants arise in diverse genetic and geographic backgrounds, are efficiently transmitted, and are present in novel lineages, including those of current global interest. They often occupy recurrent deletion regions (RDRs), which map to defined antibody epitopes. Deletions in RDRs confer resistance to neutralising antibodies. By altering stretches of amino acids, deletions appear to accelerate the antigenic evolution of SARS-CoV-2 and may, more generally, drive adaptive evolution.

In the highly likely scenario of endemic SARS-CoV-2 in regions of the world and in our country, COVID-19 joins other airborne communicable diseases that have long been serious public health problems: Acute respiratory infections (ARI) (the leading cause of death in children under five in many countries), tuberculosis and seasonal influenza. This scenario would require, once the contingency has passed, the development of a consolidated prevention and detection program that includes a variety of airborne diseases, including COVID-19.

V. Changing food consumption, as urgent as vaccines

Industrial food production constitutes the greatest risk for the emergence of new zoonotic diseases and pandemics; its expansion favors the destruction of natural habitats and their

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[23] *Phillips, N., The virus will become endemic,* ***Nature****, | Vol 590 | 18 February 2021*

[24] *McCarthy KR, Rennick LJ, Nambulli S, Robinson LR, y cols. Recurrent deletions in the SARS-CoV-2 spike glycoprotein drive antibody escape.* ***Science****. 3 Feb 2021.: eabf6950. doi: 10.1126/science.abf6950. PMID: 33536258.*

biodiversity; it is one of the main sources of soil and water contamination; it favors land grabbing and land dispossession, as well as contributing to almost a third of greenhouse gas emissions. It is therefore worrying that in the face of evidence that some of the most devastating consequences of the COVID-19 pandemic have been increased poverty, inequality and hunger, the intensification of industrial food production is being proposed as a solution[25].

The major pandemics that humanity has experienced have had a zoonotic origin. The viruses that have emerged in this century - H1N1, SARS, MERS and now SARS-Cov-2 are a case in point. No virus of zoonotic origin has been eradicated. The scale and conditions of confined animal production and slaughter for human consumption, even in the most industrialised countries, do not have infallible biosecurity conditions that prevent the possibility of viruses that can "jump" from animals to humans and vice versa[26]. The world's one billion pigs, almost 2 billion chickens and 1.5 billion cows are dispersed and increasing worldwide in frequent enclosures of more than 100,000 animals each[27], on a planet where 70% of all birds are chickens and hens and 60% of all mammals including humans are cows and pigs on farms or in factories[28]. "70% of all birds are chickens and hens and 60% of all mammals including humans are cows and pigs on farms or in factories" needs to be emphasized. Most consumers are unaware of this and the fact that most of the food we consume is "unnatural" and potentially dangerous. And that this is the cause for the spread of viruses. And that these unnatural foods are "a major determinant of the high prevalence of metabolic diseases and overweight, which are the main underlying cause of the high frequency of severe COVID-19 cases and deaths

Now, more than ever, it is urgent, in addition to limiting the expansion of intensive animal production for human consumption and industrial agriculture, to take measures to protect and strengthen traditional agro-ecosystems and to promote the consumption of fresh food for healthy eating, which is also of fundamental importance for the development of a gut microbiota whose importance is crucial for the body to generate an adequate immune response.

Industrial agriculture is structurally and functionally intimately articulated with the ultra-processed food industry. The excessive consumption of these products is a major determinant of the high prevalence of metabolic diseases and overweight, which are the main underlying cause of the high frequency of severe COVID-19 cases and deaths in our country. In October 2021 there should be an opportunity, perhaps one of the last, for the international community to agree and take urgent action to contain and reverse the current trend to both intensify and expand hyper-industrial modes of agriculture. In that month, the UN Secretary-General will convene a Food Systems Summit with the aim of maximising the

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[25] *Naciones Unidas,* ***Global Humanitarian Overview 2021****. N. York. Disponible en: https://reliefweb.int/report/world/global-humanitarian-overview-2021-enarfres*

[26] *Wallace, Rob,* ***Big Farms make Big Flu****, Monthly Review Press. N. York, 2016*

[27] *Harari N, Yuval, Industrial Farming is one of the worst crimes in history,* ***The Guardian****, 25 de September de 2015.*

[28] *Food Security Center, 70% of all birds on earth are farmed poultry,* ***FSC****, Mayo 18, 2020. Disponible en: https://www.foodsecuritycenter.org/seventy-percent-of-birds-are-farmed-poultry/*

co-benefits of a food systems approach across the 20-30 Agenda and addressing the challenges of climate change. The summit has as one of its main objectives to promote the transformation of food systems, particularly in the wake of the problems highlighted by the COVID-19 pandemic. The summit should be also an opportunity to start see the FAO Committee on Food Security's Voluntary Guidelines on Food Systems and Nutrition[29] implemented. These Voluntary Guidelines were adopted in February 12, 2021. The Voluntary Guidelines is a non-binding instrument, but which has been submitted for consultation in all regions of the world and whose text and spirit can make an important contribution to promoting substantive changes in food production and consumption policies. In the medium and long term, the measures decided there and subsequently promoted will be as important as vaccines in containing and preventing pandemics. There are well-founded fears, however, that the summit will be captured by the corporate interests of the powerful food industry[30]. The role Mexico could play in this summit will be decisive both in its own right and in influencing other countries and governments in the region. The summit and the voluntary guidelines can be a valuable instrument to protect our country's remaining traditional agro-ecosystems and biodiversity and to create conditions to protect humanity from the emergence of pandemics similar to COVID-19, or even more devastating.

VI. Transparency and precautionary measures to prevent future pandemics

Although the WHO team that visited Wu Han to investigate the origin of the coronavirus that caused the COVID-19 pandemic publicly stated that there is no evidence that it came from a laboratory, and more specifically that it did not come from the top biosafety level laboratory (BSL-4) in Wu Han, the Wu Han laboratory, like 15 other laboratories in the United States and several others in other countries, holds an extensive collection of viruses that have been harvested and tested in China, These laboratories hold extensive collections of viruses that have been studied and genetically engineered (many of them from bats) for experimental studies of their ability to infect human tissue. The suspicion that led to the WHO experts' visit and the expressions of concern by many researchers from different parts of the world is that Wu Han's BSL-4 laboratory and other similar laboratories are storing and experimenting with viruses that have the potential to cause a pandemic like the one the world is currently experiencing, or even have the potential to produce catastrophes of greater magnitude. For this to happen, it does not require a deliberate act, but only a small accident or oversight, such as those that have been reported in dozens of facilities with the same level of security measures. There is collaboration and exchange between laboratories

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[29] Committee on World Food Security, **The CFS Voluntary Guidelines on Food Systems and Nutrition** (VCFSyN) FAO/CFS, Rome February 12, 2021. Available in: http://www.fao.org/fileadmin/templates/cfs/Docs1920/Nutrition_Food_System/Negotiations/NE_982_47_8_VGFSYN.pdf

[30] *Michael Fakhri, Hilal Elver and Olivier De Schutter, The UN Food Systems Summit: How not to Respond to the Urgency of Reform,* ***InterPress Service****, Nueva York, March22 de 2021. Disponible en: http://www.ipsnews.net/2021/03/un-food-systems-summit-not-respond-urgency-reform/*

that house these types of microbial life forms in different countries, as well as sharing various sources of funding.
The more than two and a half million deaths and nearly 120 million people who have fallen ill due to SARS-COV-2 should be more than enough for the international community to demand more control and transparency, and even to limit this type of experimentation. As some well-documented investigative journalistic sources point out, the selected elite researchers working in such laboratories not only know each other, but also collaborate with each other. Some of them have also contributed to research into the origin of the coronavirus, the design of drugs and even vaccines to contain the pandemic, which clearly constitutes a serious conflict of interest.

VII. Memory and the future

In the now distant 1970s, when global warming was not yet known, the rudimentary cybernetic resources available were used in a visionary way to generate a serious global warning that was embodied in the book "The Limits to Growth"[31]. This publication was the product of a study commissioned by the Club of Rome from a team at Massachusetts Tech, which took longer to be published than to be labelled a neo-Malthusian, doomsday tool. In the context of the Cold War that dominated those years, "the report gave rise to more political than scientific discussions," said Professor Dennis Meadows, one of the three authors of the study, when interviewed by the BBC in London in 2019. This interview took place only a few months before the start of the COVID-19 pandemic, and was mainly because the predictive study, produced by MIT, pointed out that without effective measures to reduce growth, the effects of humanity's decline would begin to be felt in the 2020s. During the BBC interview, Meadows pointed out that access to and use of better cyber resources and information have strengthened the same hypothesis of the study, with the difference - Meadows points out - that now we no longer have time to manoeuvre.
2019 was also a year of large mobilisations of young people from many corners of the planet to protest the lack of action by governments and international organisations in the face of the climate crisis. News of the arrival of the new year 2020 was interspersed with news of huge and devastating fires in Australia, the Amazon region and vast regions of Siberia and California.
All indications were that the climate crisis was entering a new phase; according to various reports, the melting of ice at the poles and glaciers had accelerated and temperatures were reaching record highs in several parts of the world. The climate crisis agenda was at the top of the agenda and almost everyone was convinced that there was not a minute to lose. However, the pandemic emerged and the new threat distracted all attention.
The world forgot about the climate crisis and attention and resources shifted focus. Resources that could have been used for climate change adaptation and mitigation have been successively diverted to fans, medicines and, now, to buying vaccines.

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[31] *Meadows H Donella, et al,* ***The Limits to Growth****, Universe Books N. York, 1971.*
http://pinguet.free.fr/meadows72.pdf

Neither the direction nor the pace of climate change has changed, only that, momentarily, news of its effects has moved to the inside pages of newspapers and its technical reports to the pile of pending documents.

However, the pandemic has also brought us lessons; a painful pedagogy of the virus, as Boaventura de Sousa points out).[32] One of the most surprising and hopeful lessons, however, is that the weeks of increased confinement, during which mobility and consumption were reduced, had as an unexpected response: clear skies, less din, less smoke. Less concentration of greenhouse gases. Animals reappeared and took back their spaces. It was like going back to a time when the world was more habitable. The deadly virus has also given us a glimpse of what the world would be like without us; or what it could still be like with us, if we are able to change.

If the vaccines against COVID-19 prove to be effective solely in returning humanity to a normality similar to that which existed before the pandemic, with no ancillary efforts to address climate change, food systems and severe inequalities of health and well-being, we will still be on a deadly path in the long term.

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Conflicts of Interest Statement

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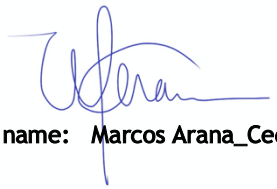

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[32] *Dos Santos, Boaventura.* ***La Cruel Pedagogía del Virus*** *(The cruel padagogy of the virus), AKAL, Mexico. Available in: https://www.akal.com/media/imagenes/Cruel_pedagogia_virus.pdf*


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